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(54) Apparatus and process for producing apertured non-woven fabric.

(57) The present invention provides an apparatus and a process for producing apertured non-woven fabric wherein a fibrous web (48) is introduced onto a support means (11) having a plurality of projections (13) regularly formed on its surface (12) and drainage holes (14) formed therethrough. High velocity water jets are directed at the fabric so that the projections (13) deflect aside fibres of the fibrous web lying on the projections towards surface zones of the body defined between the projections whereby to form apertures in the fibrous web and simultaneously randomly to entangle together the fibres lying on said surface zones.

FIG. 9

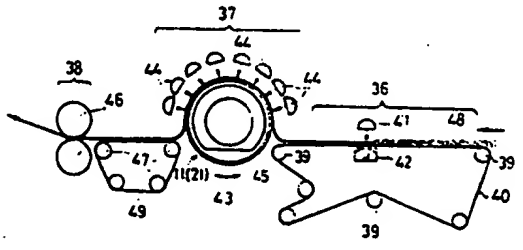
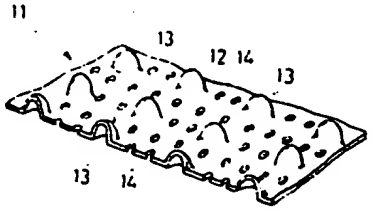


FIG.2



EP 0 215 684 A2

Description

APPARATUS AND PROCESS FOR PRODUCING APERTURED NON-WOVEN FABRIC.

The present invention relates to an apparatus and a process for producing apertured non-woven fabric. Conventional techniques for producing apertured non-woven fabric include the following:

(1) There has already been proposed the process In which fibrous web is placed on support meshes, and then high velocity water streams are jetted thereonto from above to distribute fibres aside and simultaneously to randomly entangle fibres with each other. At the same time, drainage is effected under suction from below said meshes. This process is disclosed, for example, in U.S. Patent No. 3,485,706. According to this well-known process, nackles of said meshes are utilized to form apertures in the fibrous web. However, the water streams jetted thereonto pass through said support meshes, so that it is impossible to use the energy provided by the water streams sufficiently for treatment of fibre entanglement. Certainly it is possible to form apertures in the fibrous web, but the efficiency of fibre entanglement is too low to achieve a desired strength of fibre entanglement. Furthermore, the nackles have insufficient height to achieve the fibre distributing effect. In consequence, the apertures formed in the finished non-woven fabric are unclearly defined due to fibres remaining inside the apertures.

(2) A process is already well known in which a fibrous web is placed on support meshes and a patterning plate having a plurality of holes corresponding to a pattern in which apertures are to be formed in the fibrous web is placed on the fibrous web, and then high velocity water streams are jetted from above onto the patterning plate to achieve the fibre distributing effect as well as fibre entangling treatment. Suction-drainage is effected simultaneously from below said support meshes. This process is disclosed, for example, in U.S. Patent Nos. 3,240,657 and 2,862,251. According to this process, the fibres lying below the zones of the patterning plate in which said holes are not present are free from the influence of the water streams. The fibres lying below the respective holes of the patterning plate also can not obtain a desired strength of fibre entanglement, since, as in process (1), the water streams pass through said support meshes and it is impossible to utilize sufficiently their energy for fibre entangling treatment. Moreover, the apertures formed in the finished non-woven fabric are unclearly defined due to fibres remaining therein.

(3) There has also already been proposed a process in which the fibrous web is placed on a patterning plate having a plurality of holes corresponding to a pattern in which apertures are to be formed in the fibrous web, and then high velocity water streams are jetted thereonto from above to achieve the fibre distributing effect as well as fibre entangling treatment. Suction-drainage is effected simultaneously from below the patterning plate. This process is disclosed, for example, in Japanese Laid-Open Patent Application No. 52-59774. According to this process, the patterning plate includes planar zones having no holes and contributing to the fibre entanglement. However, the apertures in the fibrous web are formed in that the fibres lying on the zones of the patterning plate in which said holes are not present are displaced under the action of the water streams into said holes in which no fibre entanglement is promoted. In consequence, efficiency and strength of fibre entanglement are not adequately satisfactory and the apertures formed in the finished non-woven fabric are unclearly defined due to fibres remaining therein.

Furthermore, the afore-described known processes require a high flow rate as well as a high jetting pressure of the water streams to obtain a non-woven fabric having a desired strength and relatively clear apertures. Such requirements disadvantageously increase the cost of production.

An object of the present invention is to provide an apparatus and a process for producing apertured non-woven fabric having more clearly defined apertures than has been the case hitherto.

In accordance with a first aspect of the present invention there is provided a process for producing apertured non-woven fabirc, characterised by the steps of introducing a fibrous web onto a support means consisting of a body having a plurality of projections carried on a smooth surface thereof in a first regular array and a plurality of drainage holes formed therein in a second regular array, and, by means of jets of water from a plurality of orifices arranged at a predetermined pitch transversely of said fibrous web, deflecting aside fibres of said fibrous web lying on said projections towards surface zones of said body defined between said projections so as to form apertures in said fibrous web and simultaneously randomly to entangle together said fibres lying on said surface zones, while draining said water streams which have completed their function for the treatment of fibres through said drainage holes by suction means provided adjacent said support means.

In accordance with a second aspect of the present invention there is provided an apparatus for producing apertured non-woven fabric comprising a support means having a plurality of drainage holes therein and on which a fibrous web can be supported, a plurality of orifices arranged to direct water jets against the fibrous web on the suport means, and a suction means disposed adjacent the support means for draining water from the jets which has passed through the fibrous web, characterised in that the support means comprises a body having a plurality of projections carried on a smooth surface thereof in a first regular array and a plurality of drainage holes formed therein in a second regular array, whereby, in use, upon directing said water jets against the fibrous web, said projections deflect aside fibres of said fibrous web lying on said projections towards surface zones of the body defined between said projections so as to f rm apertures in the fibrous web and simultaneosuly randomly to entangle together said fibres lying on said surface zones.

The present process can be used to produce apertured non-woven fabric having an excellent fibre

rearrangement and a desired tensile strength by causing fibre entanglement at surface zones on which the water streams rebound and twice contribute to fibre entanglement, while effective drainage is obtained through the plurality of drainage holes carried regularly on the support means so that the efficiency of fibre entanglement may be improved at a low jetting pressure and a small flow rate of the water streams.

The invention is described further hereinafter, by way of example only, with reference to the accompanying drawings, in which:-

Fig. 1 is a perspective view showing a first embodiment of cylindrical support means;

Fig.2 is a fragmentary perspective view showing a part of the cylindrical support means as developed to an enlarged scale;

Fig.3 is a view similar to Fig.2 but showing a second embodiment of cylindrical support means;

Fig.4 is a view similar to Fig.1 but showing a third embodiment of cylindrical support means;

Fig.5 is a view similar to Figs. 2 and 3 but showing the third embodiment of cylindrical support means;

Fig.6 is a sectional view taken along a line 6-6 in Fig.5;

Fig.7 is a sectional view taken along a line 7-7 in Fig.5;

Fig.8 is an enlarged sectional view taken along a line 8-8 in Fig.5;

Fig.9 is a schematic diagram showing a part of non-woven fabric producing apparatus including the cylindrical support means and suction means arranged in the interior of said support means;

Fig.10 is a photographic illustration showing apertured non-woven fabric produced using the first embodiment of cylindrical support means as viewed from above as magnified five times;

Fig.11 is a photographic illustration showing apertured non-woven fabric produced using the third embodiment of cylindrical support means as viewed from above as magnified five times;

Fig.12 is a diagram indicating dimensions of various parts of the third embodiment of cylindrical support means used in Example 2; and

Figs. 13 and 14 are photographic illustrations showing apertured non-woven fabrics of Controls 1 and 2, respectively, as viewed from above as magnified five times.

Figs. 1 to 3 show a support means 11 for fibrous web used in producing apertured non-woven fabric by treating the fibrous web with jets of high velocity fine water streams so as to randomly entangle fibres with each other. The support means 11 is realized in the form of a cylindrical body 12 having a suitable diameter and length, and comprises the body 12, a plurality of projections 13 carried at regular spacings on a smooth surface of the body 12 and a plurality of drainage holes 14 in a regular array in the surface zones defined among the projections 13.

Preferably, each of the projections 13 is so shaped as to diverge from its apex gradually towards its base, for example, in the form of a semi-sphere so that the efficiency of formation of apertures through the fibrous web may be improved and the non-woven fabric thus formed may be easily peeled off from the support means 11 without causing any fibre rearrangement or disturbance. The projections 13 may be hollow or may be solid.

To form clearly contoured apertues through the non-woven fabric when the latter is produced, each of the projections 13 preferably has a diameter of 0.3 to 15 mm and a height of 0.4 to 10 mm.

Preferably, the projections 13 are formed at a pitch of 1 to 15 mm. With a pitch smaller than 1 mm, the respective apertures would tend to merge continuously from one to another in the finished non-woven fabric and with a pitch larger than 15 mm the spacing between the respective apertures would be too large in the finished non-woven fabric.

The embodiment as shown in Fig.2 in which the drainage holes 14 are formed in the surface zones defined between the projections 13 is optimal. However, the drainage holes 14 may be formed also in the projections 13 themselves, as in the embodiment of Fig.3.

Preferably, each of the drainage holes 14 has a diameter of 0.1 to 2.0 mm and these are preferably formed at a pitch of 0.4 to 3.5 mm. The total area of the drainage holes 14 preferably occupies 2% to 35% of the effective area of the support means 11 as a whole.

With said diameter smaller than 0.1 mm, the drainage holes 14 would often be clogged with impurities of the like included in the fibrous web or the water streams and, as a result, the suction drainage effect by the suction means would be reduced. With the diameter larger than 2.0 mm, on the other hand, fibres of the fibrous web would cohere into or pass through the drainage holes 14 under the jetting pressure of the water streams and, as a result, the fibre rearrangement of the fibrous web would be disadvantageously disturbed and improvement of fibre entanglement could not be expected.

Figs. 4 to 8 show another embodiment of the support means 21. This support means 21 is realized in the form of a cylindrical body 22 having a suitable diameter and length, and comprises the body 22, a plurality of projections 24 carried at regular spacings on a smooth surface of the body 22 and drainage holes 23 formed in one side of each of the projections 24.

Preferably, each of the projections 24 is so shaped as to diverge from its apex gradually towards its base, for example, in the form of a dome so that the efficiency of formation of apertures through the fibrous web may be improved and the non-woven fabric after formation may be easily peeled off from the support means 21.

The drainage holes 23 formed in one side of each of the projections 24 themselves must open at such angle with respect to the plane of the smooth surface that the fibrous web is not forced into these drainage holes 23 when the water streams are jetted from above ont the fibrous web placed on the support means 21. The optimal angle at which these drainage holes 23 open is substantially normal (90°) to the surface of the body 22, but may be 75° to 105° (α) in practic .

Other requirements for the drainage holes 23 and the projections 24 are the same as those of the drainage holes 14 and the projections 13.

The support means 11 or 21 may be made of metallic plate such as a stainless steel plate having a hardness sufficient to cause rebounding streams when the water streams strike it, since said rebounding streams can also contribute to promote the fibre entanglement. The projections 13 or 24 may be formed by stamping of said metallic plate. However, the projections 13 may also be formed by electrodeposits on the said metallic plate so that they can be solid rather than hollow. Although the cylindrical support means as illustrated is optimal, the support means may be an endless belt or a curved plate, as desired.

It is obvious that the projections 13 or 24 may be formed in any pattern corresponding to the pattern of the non-woven fabric in which the apertures are to be forced so far as the above-mentioned requirements are met. The pattern of dotting is therefore not limited to the embodiments as shown.

Fig.9 illustrates the support means 11 or 21 as incorporated in an apparatus for producing the non-woven fabric. As such apparatus, it is preferred to employ the apparatus for producing non-woven fabric as disclosed by the applicant of the present invention in GB Patent No. 2114173 and EP Patent application No. 84300001.9. Details are described in these documents and, therefore, explanation of the apparatus and the fibrous web to be treated are limited here to its outline. The apparatus comprises a pretreatment station 36, a principal treatment station 37 and a moisture squeezing station 38. The pretreatment station 36 is supported by a group of rollers 39 and comprises a water-permeable belt 40 made of a mesh having no function in forming the apertures in the finished non-woven fabric, nozzle means 41 disposed above the belt 40 to jet high velocity fine water streams, and suction means 42 disposed under the belt. The principal treatment station 37 comprises the cylindrical support means 11 or 21 adapted to rotate in a direction as indicated by an arrow 43, several nozzle means 44 arranged at predetermined intervals, and suction means 45 disposed inside the cylindrical support means. Both the projections 13 and the drainage holes 14 provided for the support means 11 have no particular orientation but those 23 and 24 provided for the support means 21 have such an orientation that the drainage holes 23 open in a direction opposite to that in which the fibrous web 48 travels (i.e., facing the arrow 43). The moisture squeezing station 38 comprises a pair of press rollers 46. The orifices of the nozzle means each have preferably a diameter of 0.05 mm to 0.2 mm and a pitch of 0.5 mm to 3 mm, and the pitch should be shorter than that of the projections 13 or 24.

The fibrous web 48 formed, for example, in a card is introduced onto the belt 40 on which the fibrous web 48 is subjected to a preliminary fibre entangling treatment by high velocity fine water streams jetted through orifices of the respective nozzle means 41 from above, and then the water streams which have completed their action upon the fibrous web are drained by the suction means 42. The fibrous web 48 having its fibres entangled together to a certain degree in this step of pretreatment is then introduced onto the support means 11 or 21 on which the fibrous web 48 is subjected to the final treatment of fibre entanglement and simultaneous formation of apertures by the water streams jetted through orifices of the respective nozzle means 44, and then the water streams which have completed their action upon the fibrous web are drained by suction means 45. The non-woven fabric in which the desired apertures and fibre entanglement have been formed by the final treatment is transferred by a transfer belt 49 supported by a group of rollers 47 to a pair of squeezing rollers 46 between which a moisture content of said non-woven fabric is removed, and further transferred to subsequent steps such as those of drying and taking-up. It should be understood here that, although said web immediately after formation is so loose and fluffy that the fibres thereof are puffed out or dispersed under the jetting pressure of the water streams and, therefore, such fibrous web would not be suitable to form the apertures in the fibrous web 48, the formation of apertures can be more stably and more efficiently carried out at said principal treatment station, since the fibrous web 48 is subjected to said preliminary fibre entangling treatment as mentioned above.

As the material for the fibrous web 48, every kind of fibre conventionally used for non-woven fabrics may be employed in the form of a random web, a parallel web or a cross web, and their basic weight is preferably 15 to 100 g/m^2.

The jetting pressure of the water streams is preferably 5 to 100 Kg/cm^2, and particularly 40 to 90 Kg/cm^2. At a pressure lower than 5 Kg/cm^2, an energy insufficient to cause the fibre entanglement could be obtained, resulting in unsatisfactory effect both for the fibre entanglement and the formation of apertures, even when an amount of water is increased. At a pressure higher than 100 Kg/cm^2, on the other hand, the cost would increase to a level which is commercially disadvantageous. The water delivery quantity is preferably 1 to 20 ℓ/m^2. At a water delivery lower than 1 ℓ/m^2, the result would be poor with respect to both the fibre entanglement and the formation of apertures in regard to the jetting pressure of the water streams. The water delivery depends on the jetting pressure, number of the orifices and the diameter of each orifice. However, even when the water delivery is higher than 20 ℓ/m^2, both the fibre entanglement and the formation of apertures are not proportionally improved, so such effort would be economically disadvantageous.

The water streams jetted from above onto the fibrous web 48 distribute aside fibres lying on the projections 13 or 24 towards the surface zones defined among the projections 13 or 24 to form apertures in the fibrous web 48 and simultaneously to cause the fibres thus forcibly distributed aside towards said surface zones to be entangled together. The water streams having completed their action upon the fibres are drained by the suction means 45 through the drainage holes 14 or 23. The fibres on said surface zones can sufficiently entangle together and strongly cohere by the action of the water streams and their rebounding streams when the water streams jetted from above strike said fibres and said surface zones. It should be noted here that the

fibres lying on said surface zones would not cohere into or pass through the drainage holes 14 or 23 under the jetting pressure of the water streams. Therefore, the efficiency achieved by the support means according to the present invention is substantially higher than that achieved by the conventional support means made of meshes.

Thus, the present invention permits the formation of apertures to be clearly defined and the fibre entanglement to be sufficiently achieved even under water streams of relatively low pressure and thereby makes it possible to produce an apertured non-woven fabric of good fibre rearrangement and desired strength at a low cost. Such apertured non-woven fabrics are suitable for utilisation as materials for absorbent articles, clothing and ornaments, etc.

Example 1:

Using the apparatus as shown by Fig.9, 100% polyester fibrous web with a basic weight of 30 g/m^2 was treated with columnar water streams at a jetting pressure of 70 Kg/cm^2 and a water delivery of 9.5 ℓ/m^2 to form apertured non-woven fabric as shown in Fig.10. The fibrous web was 3 m wide and passed at a speed of 70 m/min under water streams at 2000 ℓ/min. Nozzle means having orifices, each 130 μ in diameter, were arranged at a pitch of 1 mm.

As the support means, a seamless cylinder 500 mm in diameter manufactured by the nickel-electro-forming method was employed. The support means carried a plurality of substantially semi-spherical projections, each having a diameter of 2 mm and a height of 0.8 mm, regularly formed on a surface of said cylinder so as to occupy 35% of the surface area, and a plurality of drainage holes, each 0.4 mm in diameter, were formed through the cylinder in the surface zones defined among said projections so as to be regularly presented and occupied 9% of the surface area of said cylinder.

Example 2:

Using the apparatus as shown by Fig.9, 100% polyester fibrous web with a basic weight of 30 g/m^2 was treated with columnar water streams at a jetting pressure of 70 Kg/cm^2 and a flow rate of 9.5 ℓ/m^2 as said fibrous web was fed at a velocity of 70 m/min to form apertured non-woven fabric as shown in Fig.11. Nozzle means having orifices, each 130 μ in diameter, were arranged at a pitch of 1 mm.

The support means had the following specification:

Material: stainless plate

Area ratio of projections (total area of projections/effective total area of support means): 17.5%

Area ratio of drainage holes (total area of drainage holes/effective total area of support means): 3.67%

Dimensions in Fig. 12

L_1: 5 mm, L_2: 2.86 mm, L_3: 5.45 mm,
L_4: 10 mm, L_5: 3.04 mm, L_6: 0.99 mm,
L_7: 1.58 mm.

Control 1:

Treatment was carried out under similar conditions as in Examples 1 and 2 except that the cylindrical support means used in Examples 1 and 2 was replaced by and endless belt of plain woven 10 meshes to form apertured non-woven fabric as shown in Fig.13.

Control 2:

The cylindrical support means used in Examples 1 and 2 was replaced by an endless belt of satin 76 meshes. Seamless cylinder, 380 mm in diameter manufactured according to the nickel-electro-forming technique and carrying a plurality of drainage holes each 2 mm in diameter regularly formed in its peripheral wall, was disposed around said endless belt leaving a space through which fibrous web could travel. Water streams in the form of a curtain were jetted from inside of said meshes at a jetting pressure of 15 Kg/cm^2 and a flow rate of 30 ℓ/m^2 onto the fibrous web being fed at a velocity of 10 m/min. The remainder of the treatment was performed under the same conditions as in the previous Examples and apertured non-woven fabric as shown in Fig.14 was obtained.

The apertured non-woven fabrics obtained in the above-mentioned Examples 1, 2 and Controls 1, 2 xhibited performances as set forth in the following Table.

	a basic weight (g/m^2)	thickness (mm)	tensile strength (g/5cm wide)		state of apertures (see Figs. 10, 11, 13, 14)
			MD	CD	
Example 1	29.8	0.48	11019	2242	clear
Example 2	30.0	0.598	9900	2500	clear
Control 1	30.2	0.50	6604	862	unclear
Control 2	29.3	0.77	73	10	unclear

As will be apparent from this Table, the tensile strength of MD/CD of the Examples is remarkably improved with respect to that of the Control examples.

Claims

1. A process for producing apertured non-woven fabric, characterised by the steps of introducing a fibrous web (48) onto a support means (11;21) consisting of a body (12;22) having a plurality of projections (13;24) carried on a smooth surface thereof in a first regular array and a plurality of drainage holes (14;23) formed therein in a second regular array, and, by means of jets of water from a plurality of orifices arranged at a predetermined pitch transversely of said fibrous web, deflecting aside fibres of said fibrous web lying on said projections towards surface zones of said body defined between said projections so as to form apertures in said fibrous web and simultaneously randomly to entangle together said fibres lying on said surface zones, while draining said water streams which have completed their function for the treatment of fibres through said drainage holes by suction means provided adjacent said support means.

2. An apparatus for producing apertured non-woven fabric comprising a support means (11;21) having a plurality of drainage holes (14;23) therein and on which a fibrous web (48) can be supported, a plurality of orifices (44) arranged to direct water jets against the fibrous web (48) on the support means, and a suction means (45) disposed adjacent the support means for draining water from the jets which has passed through the fibrous web, characterised in that the support means (11;21) comprises a body (12:22) having a plurality of projections (13;24) carried on a smooth surface thereof in a first regular array and a plurality of drainage holes (14;23) formed therein in a second regular array, whereby, in use, upon directing said water jets against the fibrous web, said projections deflect aside fibres of said fibrous web (48) lying on said projections towards surface zones of the body defined between said projections so as to form apertures in the fibrous web and simultaneously randomly to entangle together said fibres lying on said surface zones.

Apparatus as claimed in claim 2, wherein each of said projections (13) is so shaped as to diverge gradually from its apex portion, which has a small area, towards its base portion.

4. An apparatus as claimed in claim 3, wherein each of said projections (21) is semi-spherical.

5. An apparatus as claimed in claim 2, wherein each of said projections (21) is in the form of a dome having said drainage holes (23) in one side facing in the direction opposite to that in which said fibrous web (48) travels over the support means (21).

6. An apparatus as claimed in claim 2, wherein each of said projections has a diameter of 0.3 mm to 15 mm and a height of 0.4 mm to 10 mm.

7. An apparatus as claimed in claim 2, wherein said projections have a pitch of 1 mm to 15 mm.

8. An apparatus as claimed in claim 2, wherein said drainage holes are formed in the surface zones defined between said projections.

9. An apparatus as claimed in clam 2, wherein said drainage holes have a pitch of 0.4 mm to 3.5 mm and each of said drainage holes has a diameter of 0. 1 mm to 2.0 mm.

10. An apparatus as claimed in claim 2, wherein said drainage holes are formed over the whole extent of said support means inclusive of said projections.

11. An apparatus as claimed in claim 5, wherein said drainage holes in the one side of said projections open at an angle of 75° to 105° with respect t the plane of said support means.

12. An apparatus as claimed in claim 5, wherein said drainage holes in the one side f said projections open at an angle of substantially 90° with respect to the plane of said support means.

13. An apparatus as claimed in claim 1, wherein the total area of said drainage holes is 2% to 30% of the area of said support means.

14. An apparatus as claimed in claim 2, wherein said support means comprises a cylindrical body.

15. An apparatus as claimed in claim 2, wherein the supp rt means comprises a single cylindrical body (12) around which there are provided a plurality of nozzle means (44) arranged at predetermined spacings.

16. A process as claimed in claim 1, wherein a preliminary fibre entangling treatment step is performed prior to the steps of subjecting said fibrous web to the principal treatment of said formation of apertures and said entanglement of fibres, the preliminary fibre entangling treatment step including subjecting said fibrous web (48) on a further support means (40) to treatment with further jets of water supplied from a plurality of orifices (41) arranged at a predetermined pitch transversely of said fibrous web.

17. A process as claimed in claim 1, wherein said water streams are jetted at a pressure of 5 to 100 Kg/cm2 and a water delivery of 1 to 20 ℓ/m^2.

FIG.1

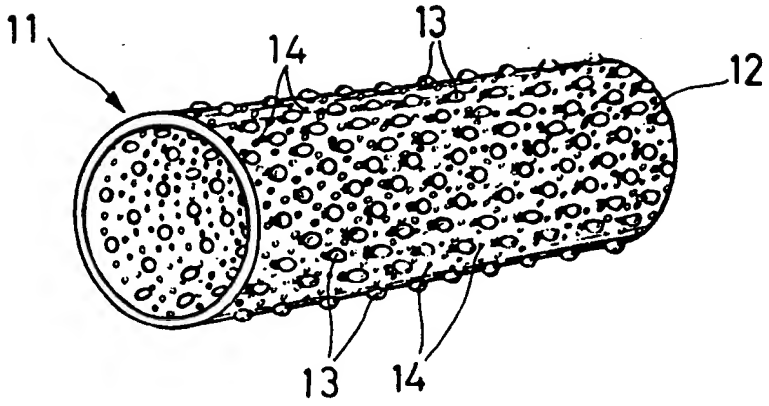


FIG.2

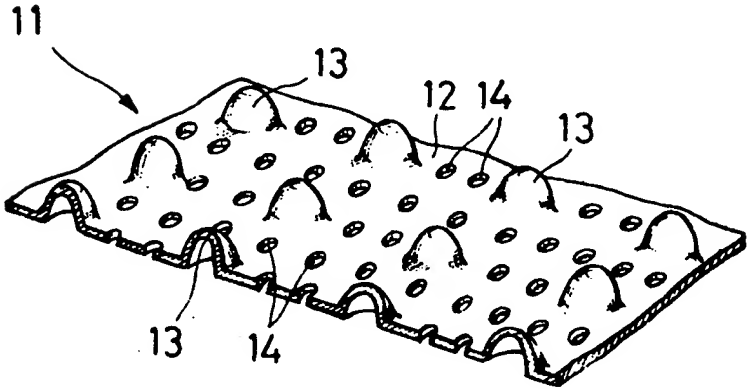


FIG.3

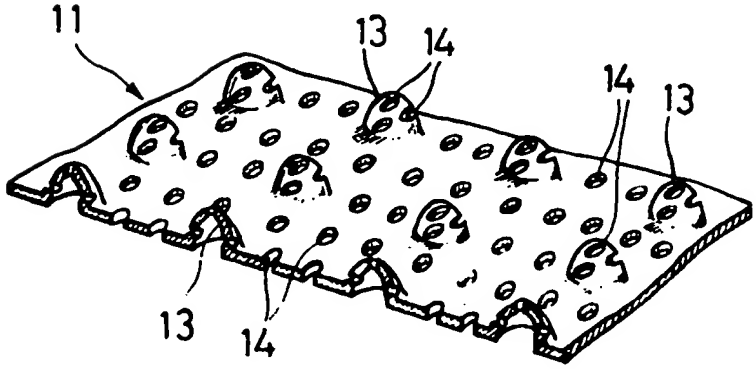


FIG.4

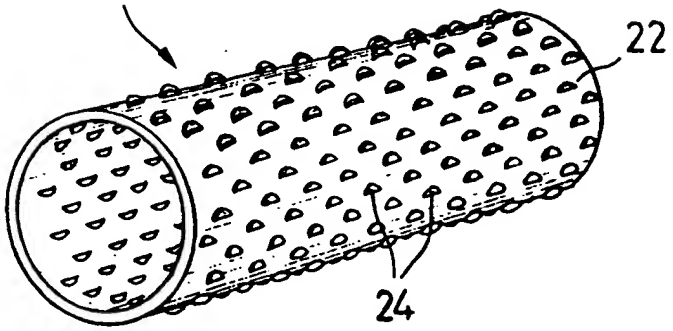


FIG.5

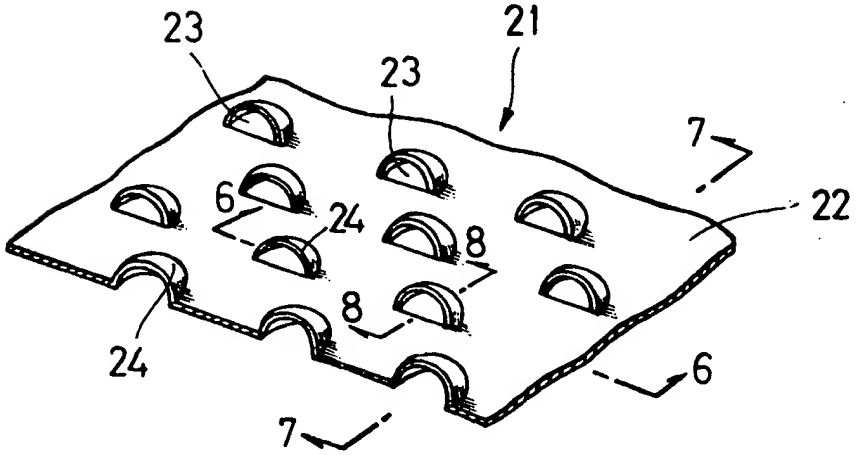


FIG.6

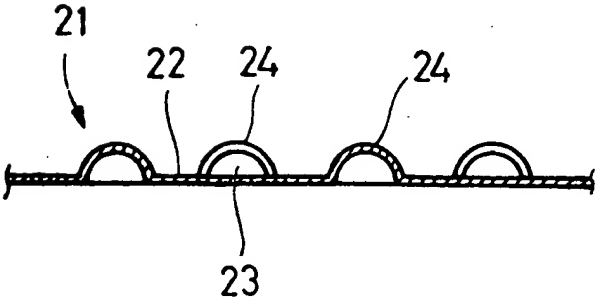


FIG.7

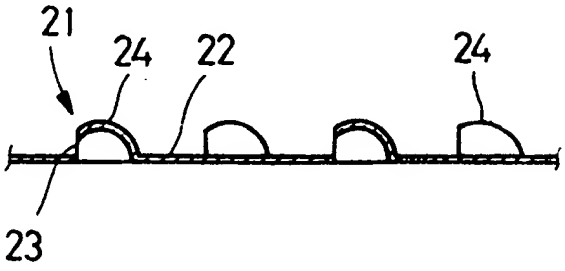


FIG.8

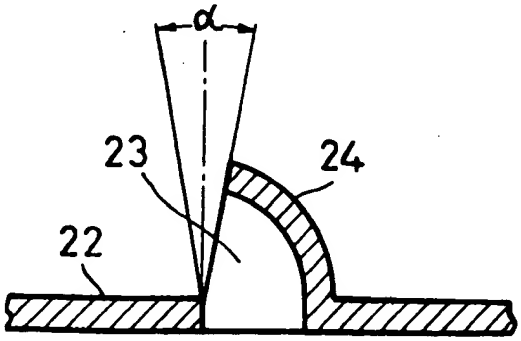


FIG. 9

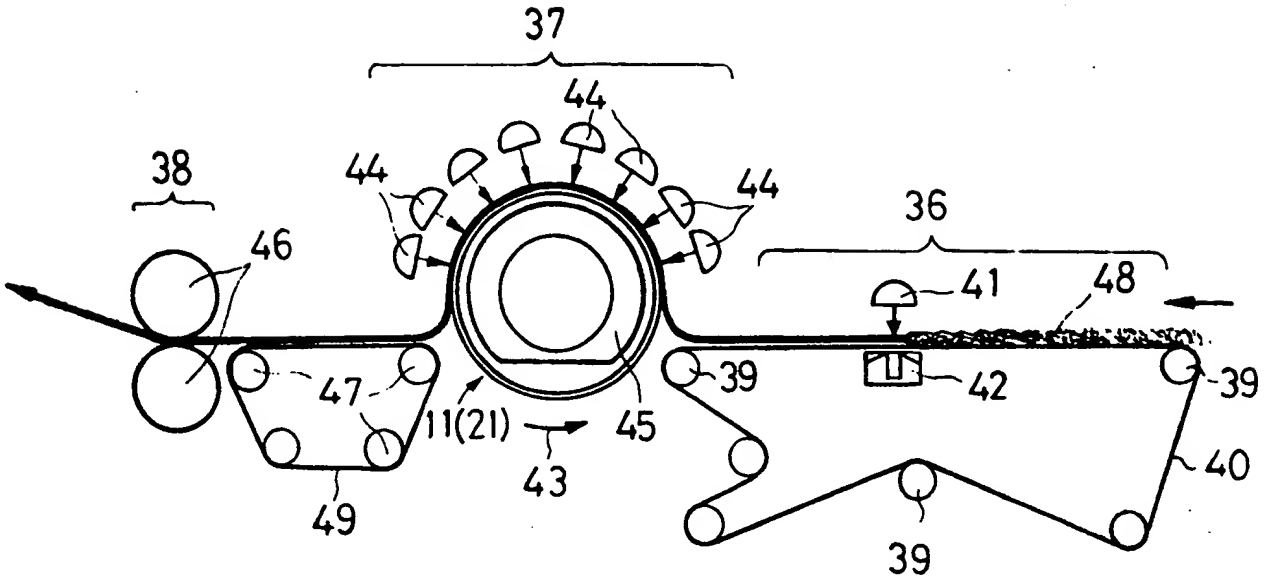


FIG. 10

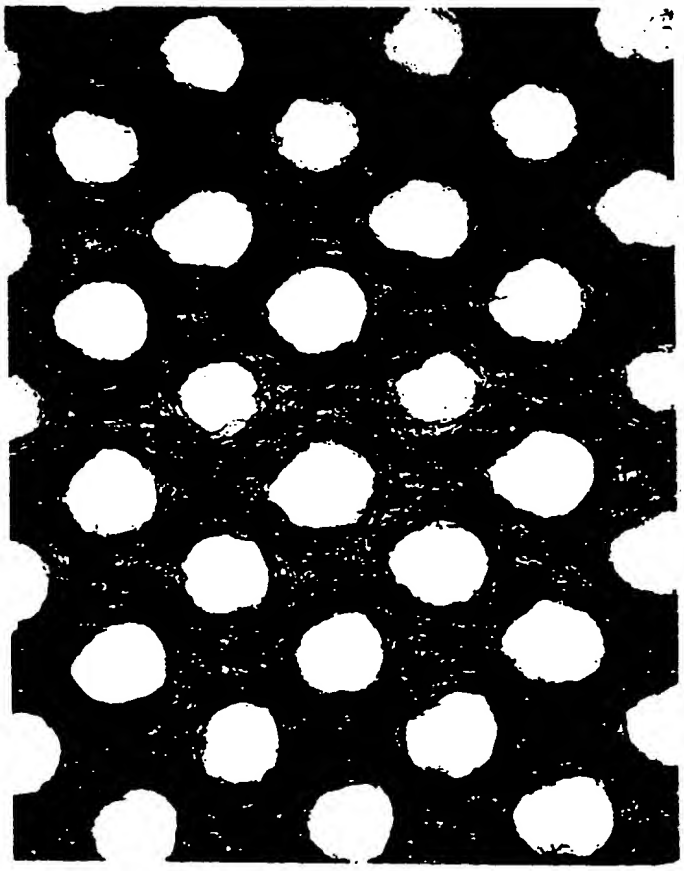


FIG.11

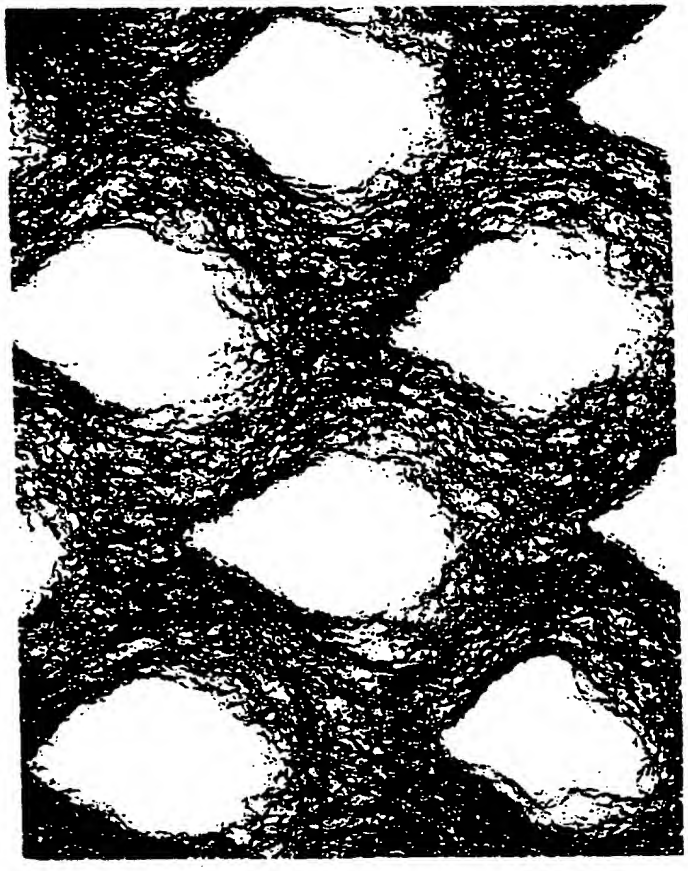


FIG.12

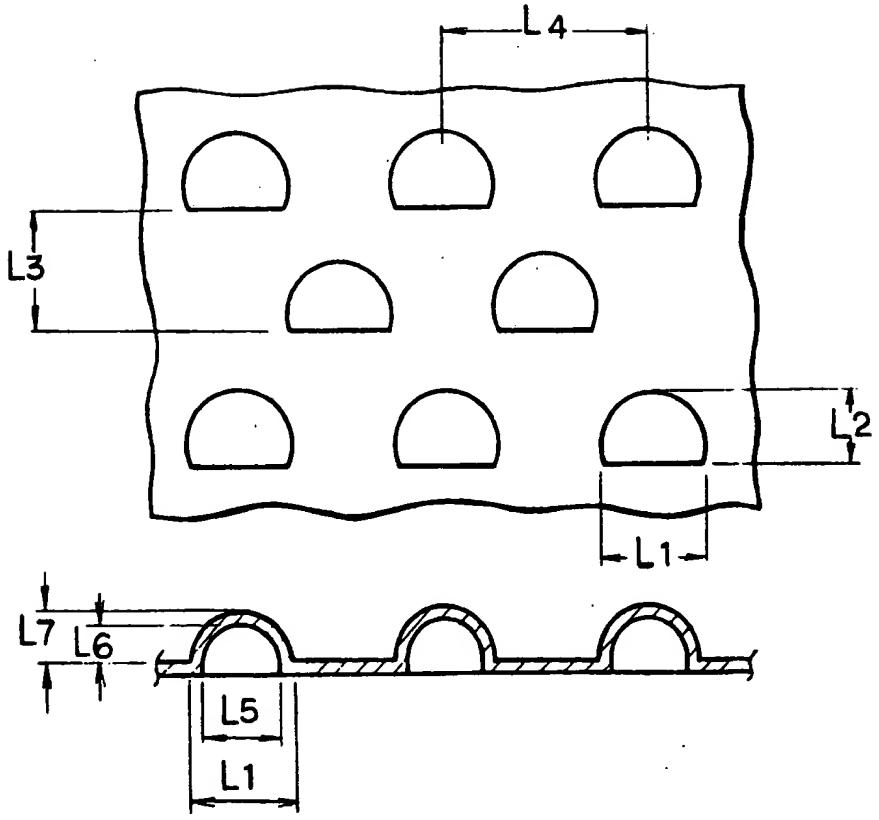


FIG.13

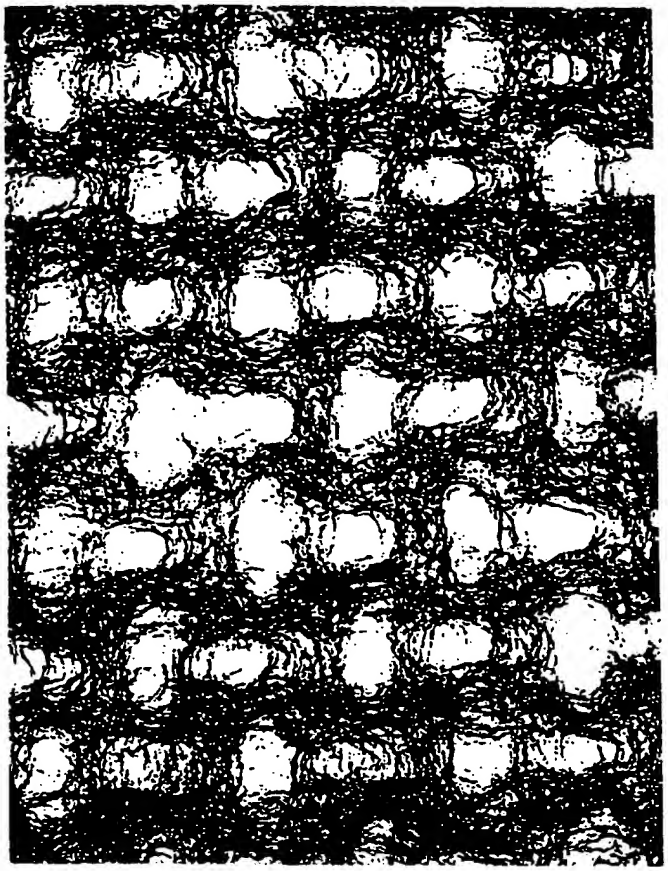
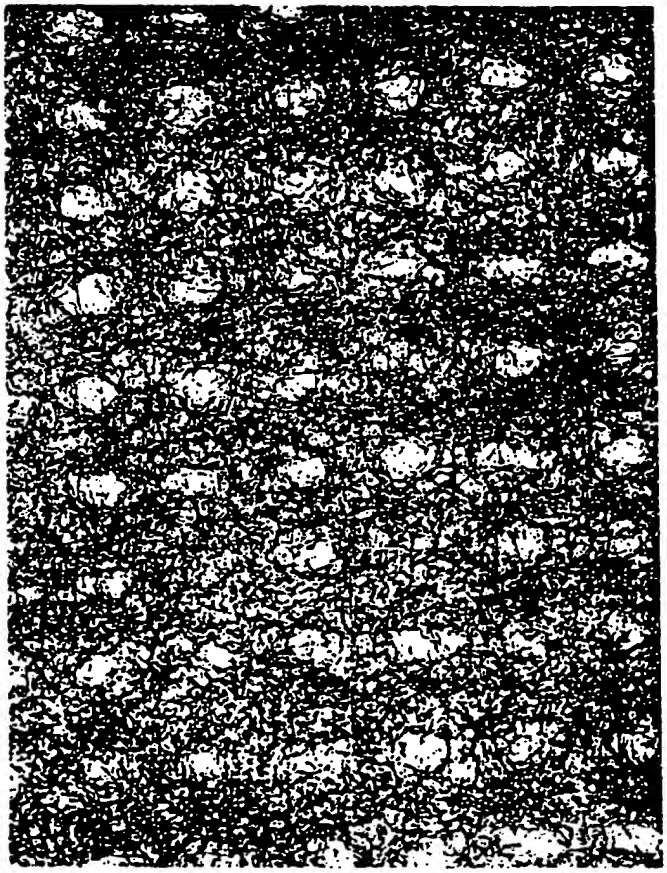


FIG.14



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(54) **Apparatus and process for producing apertured non-woven fabric.**

(57) The present invention provides an apparatus and a process for producing apertured non-woven fabric wherein a fibrous web (48) is introduced onto a support means (11) having a plurality of projections (13) regularly formed on its surface (12) and drainage holes (14) formed therethrough. High velocity water jets are directed at the fabric so that the projections (13) deflect aside fibres of the fibrous web lying on the projections towards surface zones of the body defined between the projections whereby to form apertures in the fibrous web and simultaneously randomly to entangle together the fibres lying on said surface zones.

FIG.2

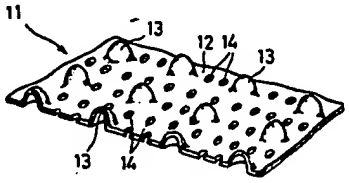
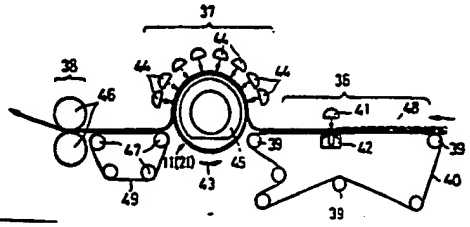


FIG.9



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EUROPEAN SEARCH REPORT

Application Number

EP 86 30 7217

DOCUMENTS CONSIDERED TO BE RELEVANT

Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (Int. Cl.4)
A	US-A-3 769 659 (F. KALWAITES) * Claims 1,2; column 2, line 44 - column 8, line 55; column 10, line 1 - column 13, line 22; example; figures 1-3,9-12 * ---	1-4,6,8,9,13	D 04 H 1/44
A	US-A-3 787 932 (F. KALWAITES) * Claims 1,3; column 2, line 30 - column 3, line 36; column 7, line 23 - column 8, line 65; column 16, line 61 - column 16, line 18; examples 1,2,5; figures 1-4,8,9,16,17 * ---	1-3,6-9,14	
A	GB-A- 920 848 (BONDED FIBRE FABRIC LTD) * Claims 1,2,4,16-25; page 1, line 42 - page 2, line 82; example 1; figures 1-3 * ---	1-3,6-9,14	
A	US-A-3 330 009 (W.J. HYNEK) * Claims 1-3; column 2, line 9 - column 8, line 64; figure 1; examples 3,7,8,13 * ---	2,5,9-12,14,17	TECHNICAL FIELDS SEARCHED (Int. Cl.4)
D,A	GB-A-2 114 173 (UNI-CHARM CORP.) * Claims 1-5; page 1, line 32 - page 4, line 8; figures 1,3,4,9,13 * -----	1,2,9,14-17	D 04 H

The present search report has been drawn up for all claims

Place of search	Date of completion of the search	Examiner
THE HAGUE	22-03-1989	BLASBAND I.

CATEGORY OF CITED DOCUMENTS

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